05-26-00

Case Docket No. 00-355

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Sir:

Transmitted herewith for filing is the patent application of:

INVENTOR: Key-Sun Choi et al.

FOR: **METHOD FOR COMPARING SIMILARITY BETWEEN PHONETIC TRANSCRIPTIONS OF FOREIGN WORD**

Enclosed are:

(XXXXX) One (1) sheet of drawings.

(XXXXX) An Assignment of the invention to Korea Advanced Institute of Science and Technology.

(XXXXX) A certified copy Korean Application No. 99-36905, Filed September 1, 1999.

(XXXXX) Verified statement to establish small entity status under 37 CFR 1.9 and 37 CFR 1.27.

(XXXXX) Information Disclosure Statement; Form PTO 1449.

The filing fee has been calculated as shown below:

	No. Filed	No. Extra	SMALL ENTITY Rate	SMALL ENTITY Fee	OTHER THAN A SMALL ENTITY Rate	OTHER THAN A SMALL ENTITY Fee
Basic Fee				$ 345		$ 690
Total Claims	4	-20 =	x 9	$	x 18	$
Indep Claims	1	-3 = 0	x 39	$	x 78	$
Multiple Dependent Claim ( ) Presented			+130	$	+260	$
			TOTAL	$ 345	TOTAL	$

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Date: May 25, 2000

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PATENT

Attorney's Docket No. 00-355

Applicant or Patentee: Key-Sun Choi et al.

Serial or Patent No.: 0 /

Filed or Issued:

For: METHOD FOR COMPARING SIMILARITY BETWEEN PHONETIC TRANSCRIPTIONS OF FOREIGN WORD

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9 (f) and 1.27(d))—NONPROFIT ORGANIZATION

I hereby declare that I am an official empowered to act on behalf of the nonprofit organization identified below:

NAME OF ORGANIZATION Korea Advanced Institute of Science and Technology

ADDRESS OF ORGANIZATION 373-1 Kusong-dong, Yusong-ku, 305-338, Taejon-si, Republic of Korea

TYPE OF ORGANIZATION

- [V] UNIVERSITY OR OTHER INSTITUTION OF HIGHER EDUCATION
- [ ] TAX EXEMPT UNDER INTERNAL REVENUE SERVICE CODE (26 USC 501 (a) and 501 (c)(3))
- [ ] NONPROFIT SCIENTIFIC OR EDUCATIONAL UNDER STATUTE OF STATE OF THE UNITED STATES OF AMERICA
  (NAME OF STATE _____)
  (CITATION OF STATUTE _____)
- [ ] WOULD QUALIFY AS TAX EXEMPT UNDER INTERNAL REVENUE SERVICE CODE (26 USC 501 (a) and 501 (c)(3)) IF LOCATED IN THE UNITED STATES OF AMERICA
- [ ] WOULD QUALIFY AS NONPROFIT SCIENTIFIC OR EDUCATIONAL UNDER STATUTE OF STATE OF THE UNITED STATES OF AMERICA IF LOCATED IN THE UNITED STATES OF AMERICA
  (NAME OF STATE _____)
  (CITATION OF STATUTE _____)

I hereby declare that the nonprofit organization identified above qualifies as a nonprofit organization as defined in 37 CFR 1.9(e) for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code with regard to the invention entitled METHOD FOR COMPARING SIMILARITY BETWEEN PHONETIC TRANSCRIPTIONS OF FOREIGN WORD

by inventor(s) Key-Sun Choi et al.

described in

- [X] the specification filed herewith.
- [ ] application serial no. 0 / _____, filed _____.
- [ ] patent no. _____, issued _____.

I hereby declare that rights under contract or law have been conveyed to and remain with the nonprofit organization with regard to the above identified invention.

If the rights held by the nonprofit organization are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

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I acknowledge the duty to file, in this application or patent, notification of any charge in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING CHOI, Duk-In

TITLE IN ORGANIZATION Representative

ADDRESS OF PERSON SIGNING 373-1 Kusong-dong, Yusong-ku, 305-338, Taejon-si, Republic of Korea

SIGNATURE Choi Duk In Date Mar 10, 2000

Express Mail No.
EL398545285US

METHOD FOR COMPARING SIMILARITY BETWEEN PHONETIC TRANSCRIPTIONS OF FOREIGN WORD

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates in general to a method for comparing/discriminating a similarity between phonetic transcriptions of a foreign word, and more particularly to a method for comparing a similarity between various phonetic transcriptions of a specific foreign word on the basis of an English pronunciation similarity comparison algorithm, which is generally used in the English-speaking world.

Description of the Prior Art

With various exchanges with foreign countries recently increasing, phonetic transcriptions of many foreign words have been used in Korean documents. Most of the phonetic transcriptions are concerned with proper nouns or technical terms originally expressed in English. In particular, it is common that scientific and technological fields have no choice but to employ the phonetic transcriptions, because there is no Korean translation for such English technical

terms.

However, there is a severe individual difference in the phonetic transcriptions of the foreign words, thus making it difficult to retrieve Korean document texts on the basis of such phonetic transcriptions. For example, three Korean phonetic transcriptions such as "디지털", "디지탈" and "디지틀" may be used together with respect to an English technical term "digital". Among these Korean phonetic transcriptions, the "디지털" has been proposed as a standard, but the "디지탈" has actually been more frequently used and, occasionally, the "디지틀" has been used according to private views.

Because various Korean phonetic transcriptions may be used together with respect to the same foreign word as mentioned above, documents with such phonetic transcriptions may not often be retrieved unless a diversity of the phonetic transcriptions is considered in the document retrieval. In order to overcome such a problem, there has been proposed a method for grouping various Korean phonetic transcriptions expressing the same foreign word into an equivalence class, indexing the grouped equivalence class and automatically expanding it upon word query [see: Jeong, K. S., Kwon, Y. H., and Myaeng, S. H., "The Effect of a Proper Handling of Foreign

and English Words in Retrieving Korean Text", In Proceedings of the 2nd International Workshop on Information Retrieval with Asian Languages (IRAL' 97), 1997].

The creation of such a phonetic transcription equivalence class requires a method for determining whether two given phonetic transcriptions are derived from the same foreign word, namely, for comparing a similarity between the two phonetic transcriptions.

The above phonetic transcription similarity comparison method is also basically necessary to an approximate search for a phonetic transcription (foreign words) database. For example, the similarity comparison method may be usefully utilized for the search for either firm names or trademarks of words of foreign origin.

However, no method has been developed until now for similarity comparison between Korean phonetic transcriptions, because Korean words are spelled using the same phonetic symbols as their pronunciations and thus in clear connection with the pronunciations. For this reason, it is very inconvenient for the user to retrieve and manage data on the basis of phonetic transcriptions of foreign words.

SUMMARY OF THE INVENTION

Therefore, the present invention has been made in view of the above problem, and it is an object of the present invention to provide a method for comparing a similarity between various phonetic transcriptions of a specific foreign word on the basis of an English pronunciation similarity comparison algorithm, which is generally used in the English-speaking world.

In accordance with the present invention, the above and other objects can be accomplished by a provision of a method for comparing a similarity between phonetic transcriptions of a specific foreign word, comprising the first step of separating each syllable of each of the phonetic transcriptions into consonants and vowels, sequentially arranging the resultant letter elements and removing all initial consonants 'o' except that of an initial letter from the arranged letter elements; the second step of removing an earlier one of successively repeated same consonants from the arranged letter elements; the third step of transforming an initial consonant of the initial letter into a predetermined representative consonant; the fourth step of substituting the remaining consonants with predetermined consonant codes; the fifth

step of removing a desired one of successively repeated same codes from the substituted consonant codes, the successively repeated same codes being sequentially final and initial consonant codes, the removed code being the final consonant code; and the sixth step of comparing the remaining consonant codes with predetermined codes based on the standard rules of foreign word transcription and determining that each of the phonetic transcriptions is the same as a standard phonetic transcription of the specific foreign word if the remaining consonant codes are equal to the predetermined codes.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a flowchart illustrating a method for comparing a similarity between phonetic transcriptions of a foreign word in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First, a brief description will be given of the technical concept of the present invention.

A method for similarity comparison between phonetic transcriptions of a foreign word in accordance with the present invention can borrow a basic methodology from an English Soundex algorithm.

Such a Soundex algorithm (see: Hall, P. and Dowling, G., "Approximate string matching", Computing Surveys, Vol. 12, No. 4, pp. 381-402, 1980) is an English pronunciation similarity comparison algorithm, which is generally used in the English-speaking world. The Soundex algorithm is mainly used to effectively perform an approximate search for a desired name from a name (names of persons, places, etc.) database on the basis of its pronunciation when it is not accurately known in spelling.

The above Soundex algorithm is adapted to compare a phonetic similarity between English words in such a manner that it removes vowels from the English words, assigns the same code to every group of analogously pronounced consonants among the remaining consonants and determines that the words are similar in pronunciation if their Soundex code strings are the same.

A detailed method for producing a Soundex code string is as follows:

(1) removes all vowels from each word;

(2) removes 'H', 'W' and 'Y' and all successively repeated same ones from consonants; and

(3) substitutes the next three letters except the initial one with Soundex codes in the below table 1.

[TABLE 1]

CONSONANTS	CODES
BFPV	1
CGJKQSXZ	2
DT	3
L	4
MN	5
R	6

If Soundex code strings (containing codes regarding the maximum four letters) of two words produced on the basis of the above table 1 are the same, then those words are determined to have similar pronunciations.

It should be noted that the above-mentioned typical Soundex algorithm cannot be applied directly to Korean words due to differences between English phonological structure and rule and Korean phonological structure and

rule. In accordance with the present invention, the existing Soundex algorithm is modified and applied in consideration of phonological characteristics of the Korean language to be adequate for the actual circumstances of the Korean language.

The similarity comparison method of the present invention is mainly adapted to compare a similarity between various Korean phonetic transcriptions derived from the same English word. In this regard, the present phonetic transcription similarity comparison method basically compares a pronunciation similarity between consonants without considering vowels. In brief, the present phonetic transcription similarity comparison method assigns the same code to every group of consonants confused in pronunciation and determines that given phonetic transcriptions are derived from the same English word if their code strings are the same.

Now, a detailed description will be given of the phonetic transcription similarity comparison method of the present invention with reference to a flowchart of Fig. 1.

First, at step S101, each syllable of a given Korean phonetic transcription of a specific foreign word is separated into consonants and vowels, or letter elements, which are then arranged in order. Subsequently, all

initial consonants 'ㅇ' except that of the initial letter are removed from the arranged letter elements.

In the case where the same consonants are successively repeated among the arranged letter elements after the initial consonants 'ㅇ' are removed at the above step S101, the earlier one (i.e., final consonant) of them (i.e., final and initial consonants) is removed at step S102 and an initial consonant of the initial letter is then transformed into a predetermined representative consonant (see the table 3) at step S103.

After the initial consonant of the initial letter is transformed into the predetermined representative consonant at the above step S103, the remaining consonants are substituted with predetermined consonant codes (see the table 2) at step S104.

[TABLE 2]

CONSONANTS	CODES
ㄱ ㄱ* ㄲ ㅋ	1
ㄴ ㄴ* ㅇ ㅇ*	2
ㄷ ㄸ ㅌ ㅅ* ㅊ	3
ㄹ ㄹ*	4
ㅁ ㅁ*	5
ㅂ ㅂ* ㅃ ㅍ ㅎ	6
ㅅ ㅆ ㅈ ㅉ	7

[TABLE 3]

CONSONANTS	REPRESENTATIVE CONSONANTS
ㄲ	ㄱ
ㄸ	ㄷ
ㅃ	ㅂ
ㅆ	ㅅ
ㅉ	ㅈ
ㅎ	ㅍ

The above table 2 shows all groups of consonants to which the present phonetic transcription similarity comparison method is applied and code values assigned respectively to the consonant groups, and the above table 3 shows representative consonants into which the initial consonant of the initial letter can be transformed.

In the above table 2, consonants marked with '*' on the right thereof signify final consonants. A Kodex algorithm permits only seven final consonants 'ㄱ', 'ㄴ', 'ㄹ', 'ㅁ', 'ㅂ', 'ㅅ' and 'ㅇ' on the basis of the standard rules of foreign word transcription [see: Notification No. 1995-8 of the Ministry of Culture and Sports in Korea, "The Rules of Foreign Word Transcription", March 16, 1995]. Further, the Kodex algorithm employs nineteen consonants defined in the standard rules of Korean pronunciation [see: Notification No. 88-2 of the Ministry of Culture and Education in Korea, "The Standard Pronunciation Rules",

January 19, 1998]. Hence, the total twenty-six consonants shown in the below table 4 are used in the present invention.

[TABLE 4]

ㄱ ㄱ* ㄲ ㄴ ㄴ* ㄷ ㄸ ㄹ ㄹ* ㅁ ㅁ*
ㅂ ㅂ* ㅃ ㅅ ㅅ* ㅆ ㅇ ㅇ* ㅈ ㅉ ㅊ
ㅋ ㅌ ㅍ ㅎ

After the the consonants are substituted with the predetermined consonant codes at the above step S104, a desired one (i.e., final consonant code) of successively repeated same codes (i.e., final and initial consonant codes) is removed from the substituted consonant codes at step S105 and the remaining consonant codes are then compared with predetermined codes based on the standard rules of foreign word transcription at step S106.

In the case where it is determined at the above step S106 that the remaining consonant codes are equal to the predetermined codes, the operation proceeds to step S107 to determine that the given Korean phonetic transcription is the same as a standard phonetic transcription of the specific foreign word. However, if it is determined at the

above step S106 that the remaining consonant codes are not equal to the predetermined codes, then the operation proceeds to step S108 to determine that the given Korean phonetic transcription is not the same as the standard phonetic transcription of the specific foreign word.

The following tables 5 to 7 show exemplary embodiments of the method for comparing a similarity between phonetic transcriptions of a foreign word in accordance with the present invention.

[TABLE 5]

PACKET	SEPARATION/ ARRANGEMENT	1st STEP	2nd STEP	3rd STEP	4th STEP	5th STEP	KODEX
패킷	ㅍ ㅐ ㅋ ㅣ ㅅ*				ㅍ13	ㅍ13	ㅍ13
패키트	ㅍ ㅐ ㅋ ㅣ ㅌ ㅡ				ㅍ13	ㅍ13	ㅍ13
팩킷	ㅍ ㅐ ㄱ* ㅋ ㅣ ㅅ*				ㅍ113	ㅍ13	ㅍ13

In the above table 5, "패킷", "팩킷" and "패키트" are Korean phonetic transcriptions expressing an English word "packet". In the present phonetic transcription similarity comparison method, those phonetic transcriptions are converted into the same code string "ㅍ13" and thus considered to be similar ones derived from the same English word.

[TABLE 6]

WINDOWS	SEPARATION/ ARRANGEMENT	1st STEP	2nd 〃	3rd 〃	4th STEP	5th 〃	KODEX
윈도우	ㅇㅜㅣㄴ*ㄷ ㅗㅇㅜㅈㅡ	ㅇㅜㅣㄴㄷ ㅗㅜㅈㅡ			ㅇ 237		ㅇ237
윈도우스	ㅇㅜㅣㄴㄷ ㅗㅇㅜㅅㅡ	ㅇㅜㅣㄴㄷ ㅗㅜㅅㅡ			ㅇ 237		ㅇ237
윈도즈	ㅇㅜㅣㄴㄷ ㅗㅈㅡ	ㅇㅜㅣㄴㄷ ㅗㅈㅡ			ㅇ237		ㅇ237

[TABLE 7]

SOUND	SEPARATION/ ARRANGEMENT	1st STEP	2nd 〃	3rd STEP	4th STEP	5th 〃	KODEX
싸운드	ㅆㅏㅇㅜ ㄴ*ㄷㅡ	ㅆㅏㅜ ㄴㄷㅡ		ㅅㅜㄴ* ㄷㅡ	ㅅ23		ㅅ23
사운드	ㅅㅏㅇㅜ ㄴ*ㄷㅡ	ㅅㅏㅜ ㄴ*ㄷㅡ		ㅅㅜㄴ* ㄷㅡ	ㅅ23		ㅅ23

As apparent from the above description, according to the present invention, the foreign word phonetic transcription similarity comparison method is capable of rapidly retrieving various data and indexes with mixed phonetic transcriptions of foreign words without confusion. Therefore, the present invention provides a similar transcription retrieval standard adequate to the Korean language.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes,

those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. A method for comparing a similarity between phonetic transcriptions of a specific foreign word, comprising the steps of:

a) separating each syllable of each of said phonetic transcriptions into consonants and vowels, sequentially arranging the resultant letter elements and removing all initial consonants 'O' except that of an initial letter from the arranged letter elements;

b) removing an earlier one of successively repeated same consonants from the arranged letter elements;

c) transforming an initial consonant of said initial letter into a predetermined representative consonant;

d) substituting the remaining consonants with predetermined consonant codes;

e) removing a desired one of successively repeated same codes from the substituted consonant codes, said successively repeated same codes being sequentially final and initial consonant codes, said removed code being said final consonant code; and

f) comparing the remaining consonant codes with predetermined codes based on the standard rules of foreign word transcription and determining that each of said phonetic transcriptions is the same as a standard phonetic

transcription of said specific foreign word if the remaining consonant codes are equal to said predetermined codes.

2. The method as set forth in Claim 1, wherein said predetermined representative consonant transformed at said step c) is "ㄱ", "ㄷ", "ㅂ", "ㅅ", "ㅈ" or "ㅍ".

3. The method as set forth in Claim 1, wherein said step d) includes the step of assigning a constant code "1" to the remaining constants "ㄱ", "ㄱ*", "ㄲ" and "ㅋ", a constant code "2" to the remaining constants "ㄴ", "ㄴ*", "ㅇ" and "ㅇ*", a constant code "3" to the remaining constants "ㄷ", "ㄸ", "ㅌ", "ㅅ*" and "ㅊ", a constant code "4" to the remaining constants "ㄹ" and "ㄹ*", a constant code "5" to the remaining constants "ㅁ" and "ㅁ*", a constant code "6" to the remaining constants "ㅂ", "ㅂ*", "ㅃ", "ㅍ" and "ㅎ" and a constant code "7" to the remaining constants "ㅅ", "ㅆ*", "ㅈ" and "ㅉ", respectively.

4. The method as set forth in Claim 3, wherein said mark '*' indicates that an associated consonant is a final consonant.

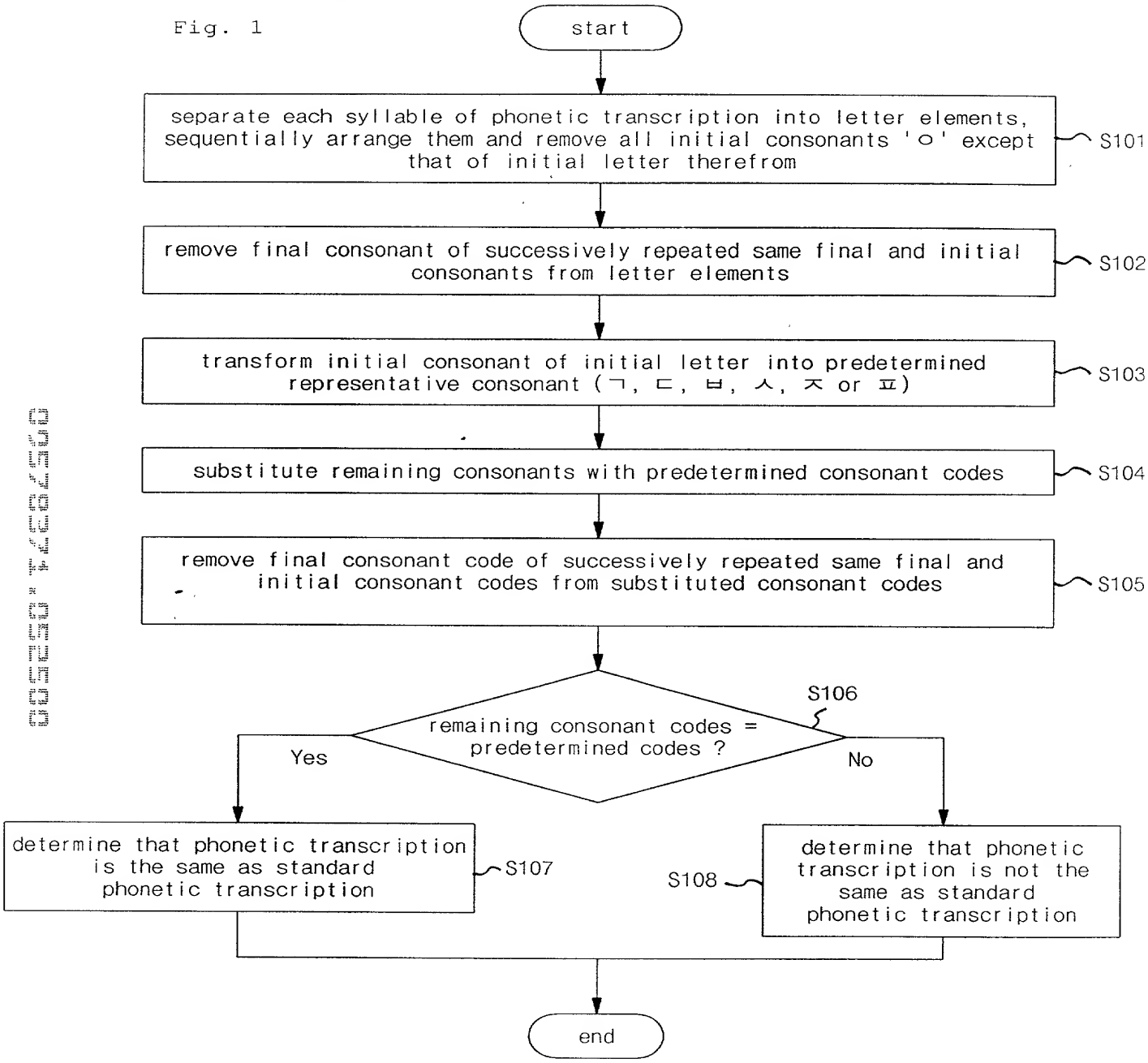
ABSTRACT OF THE DISCLOSURE

A method for comparing a similarity between phonetic transcriptions of a specific foreign word. Each syllable of each of the phonetic transcriptions is separated into consonants and vowels and the resultant letter elements are sequentially arranged. Then, all initial consonants 'o'| except that of an initial letter are removed from the arranged letter elements. An earlier one of successively repeated same consonants is removed from the arranged letter elements and an initial consonant of the initial letter is transformed into a predetermined representative consonant. The remaining consonants are substituted with predetermined consonant codes and a desired one of successively repeated same codes is removed from the substituted consonant codes. The successively repeated same codes are sequentially final and initial consonant codes and the removed code is the final consonant code. Finally, the remaining consonant codes are compared with predetermined codes based on the standard rules of foreign word transcription. If the remaining consonant codes are equal to the predetermined codes, each of the phonetic transcriptions is determined to be the same as a standard phonetic transcription of the specific foreign word. Therefore, various data and indexes with mixed phonetic

transcriptions of foreign words can rapidly be retrieved.

DRAWING

Fig. 1



PATENT

Attorney's Docket No. 00-355

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR CIP)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (*check one applicable item below*)

- ☑ original
- ☐ design
- ☐ supplemental

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

- ☐ national stage of PCT

NOTE: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR CIP.

- ☐ divisional
- ☐ continuation
- ☐ continuation-in-part (CIP)

INVENTORSHIP IDENTIFICATION

WARNING: If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

METHOD FOR COMPARING SIMILARITY BETWEEN PHONETIC TRANSCRIPTIONS OF FOREIGN WORD

SPECIFICATION IDENTIFICATION

the specification of which: (*complete (a), (b) or (c)*)

(a) ☑ is attached hereto.

(b) ☐ was filed on _____ as ☐ Serial No. 0 /_____ or ☐ Express Mail No., *as Serial No. not yet known* _____ and was amended on _____ (*if applicable*).

NOTE: Amendments filed after the original papers are deposited with the PTO which contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

(c) ☐ was described and claimed in PCT International Application No. _____ filed on _____ and as amended under PCT Article 19 on _____ (*if any*).

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information

☒ which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56

(also check the following items, if desired)

☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☒ In compliance with this duty there is attached an information disclosure statement in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119)

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

(d) ☐ no such applications have been filed.

(e) ☒ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

A. PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
KR	99-36905	01. 09. 99	☒ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

NOTE: *If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CIP APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.*

POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (*List name and registration number*)

Robert H. Bachman (19,374), Gregory P. LaPointe (28,395), Barry L. Kelmachter (29,999), and George A. Coury (34,309), all of Bachman & LaPointe, P.C., 900 Chapel Street, Suite 1201, New Haven, CT 06510-2802

(check the following item, if applicable)

☐ Attached as part of this declaration and power of attorney is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

Bachman & LaPointe, P.C.
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New Haven, CT 06510-2802

DIRECT TELEPHONE CALLS TO: (*Name and telephone number*)

Gregory P. LaPointe
(203) 777-6628

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

NOTE *Carefully indicate the family (or last) name as it should appear on the filing receipt and all other documents.*

Full name of sole or first inventor

Key-Sun (GIVEN NAME) | (MIDDLE INITIAL OR NAME) | CHOI (FAMILY (OR LAST NAME))

Inventor's signature Key Sun Choi

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Full name of second joint inventor, if any

Byung-Ju (GIVEN NAME) | (MIDDLE INITIAL OR NAME) | KANG (FAMILY (OR LAST NAME))

Inventor's signature Byungju Kang

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Full name of third joint inventor, if any

Jae Sung (GIVEN NAME) | (MIDDLE INITIAL OR NAME) | LEE (FAMILY (OR LAST NAME))

Inventor's signature

Date Mar 27, 2000 Country of Citizenship KR

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Full name of 4th joint inventor, if any

(GIVEN NAME) | (MIDDLE INITIAL OR NAME) | (FAMILY (OR LAST NAME))

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address

Full name of 5th joint inventor, if any

(GIVEN NAME) | (MIDDLE INITIAL OR NAME) | (FAMILY (OR LAST NAME))

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address

CHECK PROPER BOX(ES) FOR ANY OF THE FOLLOWING ADDED PAGE(S) WHICH FORM A PART OF THIS DECLARATION

☐ Signature for sixth and subsequent joint inventors. *Number of pages added* _____

* * *

☐ Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. *Number of pages added* _____.

* * *

☐ Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. *Number of pages added* _____

* * *

☐ Added page for signature by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time (37 CFR 1.47).

* * *

☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application.

☐ Number of pages added _____

* * *

☐ Authorization of attorney(s) to accept and follow instructions from representative.

* * *

(If no further pages form a part of this Declaration, then end this Declaration with this page and check the following item:)

☐ This declaration ends with this page.